Test form **411**

Name_

Physics 2211 ABC Fall 2014 Test 1

Recitation Section (see back of test):

1) Print your name, test form number (above), and nine-digit student number in the section of the answer card labeled "STUDENT IDENTIFICATION".



- 2) Bubble your test form number (ABOVE) in columns 1-3, skip column 4, then bubble in your student number in columns 5-13.
- 3) For each free-response question, show all relevant work supporting your answer. **Clearly box or underline your final answer**. "Correct" answers which are not supported by adequate calculations and/or reasoning will be counted wrong.
- 4) For each multiple-choice question, select the answer most nearly correct, **circle this answer on your test**, and bubble it in on your answer card. Show all relevant work on your quiz.
- 5) Be prepared to present your Buzzcard as you turn in your test. Scores will be posted to WebAssign after they have been been graded. Quiz grades become final when the next quiz is given.
- 6) You may use a simple scientific calculator capable of logarithms, exponentials, and trigonometric functions. **Programmable** engineering calculators with text or graphical capabilities are not allowed. Wireless devices are prohibited.



Your test form is: 411

The following problem will be hand-graded. <u>Show all your work for this problem</u>. Make no marks and leave no space on your answer card for it.

- [I] You are a settler in the first permanent human colony on Mars. You set out from Base Alpha in a rover, traveling 22.5° north of east at a speed of 15.0 kph. After 2.20 hours, a sudden rockslide destroys your rover's fuel cell, leaving you stranded. You have only 5.00 hours of oxygen remaining, and can only travel overland at a speed of 5.00 kph. Luckily, the colony has created a network of supply bunkers for just such an emergency. Checking your maps, you see that Bunker B is closest, located 50.0 km due northeast of Base Alpha.
- (A) *(12 points)* How far is Bunker B from your current location? What direction should you travel, in order to proceed directly toward the bunker?



(B) (8 points) Suppose that your gyro-compass was also destroyed in the rockslide, so you can't navigate directly toward the bunker. Your only choice is to travel north based on dead reckoning, until you are on a direct line between Base Alpha and Bunker B. At that point, you are able to pick up a directional radio signal that lies along a straight line between the two locations, and can follow the signal directly northeast to the bunker. How much time will be remaining in your oxygen supply when you reach safety? (Assume that while dead reckoning, you actually manage to travel <u>due</u> north.)

The following problem will be hand-graded. <u>Show all your work for this problem</u>. Make no marks and leave no space on your answer card for it.

- [II] You are a settler in the first permanent human colony on Mars, where the gravitational acceleration is $g = 3.70 \text{ m/s}^2$. You are standing atop a cliff of height H = 37.0 m, holding an apple and a banana. You throw the apple upward off the cliff with an initial speed $v_A = 3.70 \text{ m/s}$, and then after a brief delay, you drop the banana.
- (A) *(12 points)* What time delay between throwing the apple and dropping the banana will result in both objects striking the base of the cliff at the same time?

(B) (8 points) With what velocities will the two objects strike the base of the cliff?

The following problem will be hand-graded. <u>Show all your work for this problem</u>. Make no marks and leave no space on your answer card for it.

- **[III]** You are a settler in the first permanent human colony on Mars. In the gymnasium module one day, you decide to have a footrace with another colonist. The track consists of a rectangular loop of dimension $D \ge 2D$. you maintain a steady speed v_0 along the first three legs of the loop, then speed up to a speed $2v_0$ on the final stretch. Your opponent maintains a speed $3v_0/2$ for the first three legs, then becomes winded and can only maintain a speed $v_0/2$ for the last leg.
- (A) (12 points) Who wins the race? By how much time does the winner beat the loser? (Express your answer entirely in terms of D and $v_{0.}$)



(B) (8 points) What was your average speed and average velocity for the entire race? What was your opponent's average speed and velocity?

Question value 8 points

- (1) In the following expression, the symbol d represents distance, t represents time, v represents speed, and a represents acceleration magnitude. Which of the formulas below is dimensionally correct?
 - (a) $v^2/d = 3at$
 - (b) $v_f v_i = \frac{1}{2}at^2$
 - (c) $v_B^2 v_A^2 = 2a^2t$
 - (d) $(a_A^2 v_A^2 t^2)/d_A = v_B^2/d_B^2$
 - (e) $5va = d^2/t^3$

Question value 8 points

(2) A cart is given an initial shove up an inclined ramp. The cart starts at A, coasts up the track and stops at B, and then returns back down the track to A. An observer collects position data and constructs the x-vs-t graph shown at right.





At what point (if any) during the motion does the acceleration of the cart have a negative value?

- (a) The acceleration is negative *only* as it moves from A to B.
- (b) The acceleration is negative while it is moving from A to B, and from B to A, but *not* at the moment that it is stopped at B.
- (c) At no point during the cart's motion is the acceleration negative.
- (d) At all points during the cart's motion the acceleration is negative.
- (e) The acceleration is negative *only* as it moves from B to A.

Question value 8 points

(3) Each of the motion diagrams below has a coordinate system with a directional arrow denoting the "positive" direction and a crosshair indicating the origin. In which of the diagrams does position "1" correspond to the object having a positive velocity and a negative acceleration?



Question value 8 points

- (4) A stationary police car is passed by a speeding sportscar travelling with speed v_0 . After a brief delay, the police car gives chase, accelerating uniformly to speed $2v_0$ and then maintaining that speed. Both cars' velocities are graphed at right. At what time will the police car overtake the sportscar?
 - (a) At time t_3 .
 - (b) At time t_2 .
 - (c) At time t_5 .
 - (d) At time t_1 .
 - (e) At time t_4 .



Question value 8 points

- (5) In coordinate system S, a turtle has a position vector given by $\vec{r}_s = \langle 2 \text{ m}, 6 \text{ m} \rangle$. Coordinate system T has axes parallel to coordinate system S, but its origin is located at position $\vec{O}_s = \langle 3 \text{ m}, 2 \text{ m} \rangle$ in coordinate system S. What is the position vector of the turtle in coordinate system T?
 - (a) $\vec{r}_T = \langle 5 \text{ m}, 8 \text{ m} \rangle$
 - (b) $\vec{r}_T = \langle 1 \text{ m}, 4 \text{ m} \rangle$
 - (c) $\vec{r}_T = \langle 1 \text{ m}, -4 \text{ m} \rangle$
 - (d) $\vec{r}_T = \langle -1 \text{ m}, -4 \text{ m} \rangle$
 - (e) $\vec{r}_T = \langle -1 \text{ m}, 4 \text{ m} \rangle$

PHYS 2211 ABC Recitation TA and Room Assignments

Tests will be returned in recitation, in the week *after* the test. In order to ensure that you receive your test back <u>as soon</u> as possible, please enter your recitation section from the table above (G01-G10) on the front of this test.

	Clough 125	Clough 127	Clough 131	Clough 325
WEDNESDAY				
12:05 – 12:55 pm	A01 Shi, Chao			
1:05 – 1:55 pm				B01 Shi, Chao
2:05 – 2:55 pm	C01 Liberi, Brandon			A06/B02 Shi, Chao
3:05 – 3:55 pm				B05/C06 Ravipati, Akshay
4:05 – 4:55 pm		A05/C07 Strauss, Hunter		C02 Shi, Chao
5:05 – 5:55 pm	A02 Zhou, Jiarun	B06 McMahon, Brian		
THURSDAY		-	·	
12:05 – 12:55 pm	B03 Liberi, Brandon			
1:05 – 1:55 pm		C03 Kosaraju, Raj		
2:05 – 2:55 pm	B08 Kharbouch, Adel	A03 Lall, Siddharth		
3:05 – 3:55 pm		A07/B07 Lall, Siddharth	C04 Tao, Liangyu	
4:05 – 4:55 pm	A08/C08 Tao, Liangyu			
5:05 – 5:55 pm	C09 Zhou, Jiarun	A04/B09 Strauss, Hunter		
6:05 – 6:55 pm	B04/C05 Minderman, John			